Using Exergames as Social Networks: Testing the Flow Theory in the Teaching of Physical Education

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Abstract. *The aim of this pilot study was to investigate the use of networked exergame as an opportunity to teach Physical Education in cyberspace. A survey sample (n=25) played the game table tennis for XBOX Kinect in three modes: singleplayer; multiplayer and networked exergame. Intrinsic motivation was verified using the Long Flow State Scale Questionnaire (FSS-2). The energy expenditure was verified using a heart rate monitor in just 2 students, playing the game boxing. The possibility to use the cyberspace in Physical Education was tested using the chat and movement of the avatar of the XBOX Kinect system to teach table tennis techniques.*

Resumo. *O objetivo deste estudo piloto foi investigar o uso de exergames em rede como uma oportunidade para o ensino de Educação Física no cyberspace. Uma amostra de 25 estudantes universitários jogaram o jogo Table Tennis do XBOX Kinect nos 3 modos: singleplayer; multiplayer e exergame em rede. A motivação intrínseca foi verificada utilizando o Long Flow State Scale Questionnaire (FSS-2). A possibilidade de usar o ciberespaço na Educação Física foi testada utilizando o bate-papo e os movimentos do avatar do sistema kinect XBOX para ensinar as técnicas do tênis de mesa.*

1. Introduction

In health promotion, the use of Exergames against obesity has been reported by many researchers since it provides a similar energetic demand according to the recommendations from the American College of Sports Medicine for daily caloric expenditure (Biddiss and Irwin, 2010, Siegel et al., 2009; Warburton et al., 2009; Lanningham-Foster, 2009; Unnithan et al., 2006). In the pedagogic area the exergames have attracted the educators' attention in schools and universities due to its possibility of being incorporated into the curriculum. (Staiano and Calvert, 2011; Vaghetti et al., 2010).

Conceptually EXG are consoles which require a higher physical effort, in other words, a greater energy demand, for its playability, when compared to traditional videogames. Active video games, active gaming, exergaming, interactive games, movement-controlled video games, or exertion game are terms used to define this kind

of video game, in which the interface requires physical effort (Yim and Graham, 2007; Suhonen et al., 2008; Mueller 2010).

The challenges for the pedagogic practice in Physical education (PE) in the technological era come not only due to the lack of motivation for the physical activities and body practices, but mainly, according to Machado et al. (2011) with the possibility of using cyberspace and the electronic games as a curricular subject.

It was through cyberspace and due to it that the social networks (SN) have rapidly spread in people´s daily life as social platforms for communication mediated by the computer, providing an exponential increase of participants (Lin and Lu, 2011). As examples *Facebook*, *Orkut*, *Myspace*, *Sonic* between other kinds of networks such as blogs, that configure a way of interaction which is characterized by sharing information and knowledge not existing so far.

The cyberspace is also somewhere where the players can meet, the *social* games (SG) enable the network game between geographically distant users. Essentially these games were designed to be played in the SN, and they are among the most popular games in the world, including products with dozens of millions of players, such as: Top Eleven Football Manager, Farmville, and Dawn of the Dragons (Shin and Shin, 2011). Although the SG are classified as sedentary games, according to Lanningham-Foster et al. (2009), they have multiplied through cyberspace due to the SN expansion, and they represent a great job opportunity, both in the field of game design, as related to the games narrative, as Education, Mathematics, Geography, between others.

The basics of the social games, acoording Paraskeva et al., (2009), are the activity theory, developed by Vygotsky, Wertsch, Leontjev and Wenger. This principles can be the basis for the development of educational games which aim the creation of collaborative learning environments, where players are able to interact with other people, objects and game tools, under specific rules, creating communities through division of labor.

Developed by Mihaly Csikszentmihalyi in 1975, the Flow theory is related to the player´s intrinsic motivation, in which, during the Flow experience, as a mental state, the person loses all sense of time and concerns, and the performance and pleasure sensation in the activity are maximized (Csikszentmihalyi, 1990). Some authors suggest the Flow theory as an indicator of students' satisfaction concerning the cyberspace learning (Chan and Ahern, 1999; Shin, 2006; Liao, 2006). The theory is also called the ideal experience and it is closely associated to an autotelic activity, in other words, it refers to the performance of an activity without receiving any reward apparently, it is simply about pleasure (Davis et al., 1992).

Based on the concepts presented, this pilot study aimed to investigate the use of EXGs network as an opportunity to teach Physical Education in cyberspace. It verified the intrinsic motivation (Flow Theory), energy expenditure and heart rate in three different modes of playing: singleplayer, multiplayer and networked EXG.

2. Related work

Vaghetti *et al*. (2011) have investigated EXGs in networks and their use for PE. The researchers say that with regard to physical abilities required in games, in the EXGs

development area, the new prototypes require predominantly endurance and general motor coordination and in the research they were presented as a justification for the treatment of obesity. According the authors the consoles on the market (*Nintendo Wii, XBOX 360 Kinect, PS3 Move*), essentially demand coordination. The authors mentioned investigated the possibility of using audio communication between players, which would facilitate the teacher's mediation.

Lin and Lu (2011) investigated 402 social networks users through a questionnaire sent by *facebook.* The researchers tested the hypothesis that the extrinsic (usefulness) and intrinsic (fun) perceived benefits positively affect the behavior of users to continue using the system. The results suggest that the fun was the most important factor that affects the behavior of users to participate and continue to join social networks. Furthermore, the authors conclude that the systems must continue to develop applications, like new games and new ways of sharing information, so that users do not lose interest.

Hansen and Sanders (2010) investigated six elementary school students, who took part in an experiment entitled active gaming over eight weeks of physical education classes with the use of EXG. The main results indicate that the persistence of the players to remain playing is related to the flow theory. This persistence of play was defined as a natural feature of children to engage voluntarily and remain engaged in technology-oriented physical activities. The findings of that study suggest that EXG can be used in physical education classes to increase levels of physical activity in children.

3. Method

The survey sample was selected by convenience through verbal invitation at the university. The sample n = 25 was divided into three groups: Single-player (n = 7); Multiplayer (n = 8) and EXG network (n = 10).

Three instruments of measurement were used in this research: 1) Long Flow State Scale Questionnaire (FSS-2), (Jackson et al., 2010): The questionnaire FSS-2 consists of 36 questions, the answers are given in response on a Likert scale of five points (1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always). The FSS-2 was developed to be used immediately after an activity that involves human movement. 2) Exergames used: two XBOX 360, two Kinects and two Kinect Sports games (Table Tennis and Boxing). 3) Heart rate monitors: two monitors, Polar RS800CX heart rate monitor and Polar Trainer 5 software.

The participants were informed about the research procedures and also signed a consent form for the experiment. Three methodological procedures were conducted for each sample group. Single player (one player alone), Multiplayer (one player against another player playing in the same room) and EXGs network (one player playing against another player in a separated environment). All the participants in the sample played the game Kinect Sports (table tennis mode) soon after they answered the FSS-2.

The participants played a table tennis game for 15 minutes. After the match all participantes answered the questionnaire FSS-2. The energy expenditure was mesured using the HR monitor during the games, two particpantes playing table tennis and two participantes playing boxing. The energy expenditure was calculated by HR monitor

system. The possibility to use the cyberspace in Physical Education was tested using the chat and movement of the avatar of the XOBX Kinect system to teach table tennis techniques.

We used descriptive statistic with mean and standard deviation for the results and for the t-tests to detect the differences between the means of Single-player, Multiplayer and EXG network groups.

4. Results

The Flow theory was used to verify the motivation that online gaming can provide and consequently optimize learning environment.

Table 1: Flow values for the investigated groups, Single-player, Multiplayer and EXG network mode in table tennis

	Flow		
	Single-player (n=7)	Multiplayer (n=8)	EXGs network (n=10)
Mean	3.74	3.99	3.93
SD (±)	0.47	0.21	0.35
VC (%)	12.58	5.32	8.92

Although there have not been found significant differences statistically between groups, it a similarity is noticed between the mean and the flow value between the group multiplayer and the group EXGs, while the single-player group showed the lowest values.

In Table 2, it can be seen the values for maximal heart rate, the mean and the energy expenditure during the Table Tennis and Boxing games, both from (Kinect Sports).

Table 2: Values of heart rate (HR max) and average heart rate (HR average) (bpm) during the game in multiplayer mode to the table tennis and boxing games.

	kinect sports Games			
	Table Tennis Multiplayer		*Boxing Multiplayer*	
	Player 1	*Player* 2	*Player* 1	*Player* 2
HR max (bpm)	134	133	183	147
HR average (bpm)	108	107	124	114
Caloric Expenditure (cal)	61	52	126	74

It can be noticed, as per table above, the physiological differences between the two games. Both require basically the upper limbs on the gameplay, however boxing requires a higher movement speed. Consequently, the values of maximum and average heart rate, and energy expenditure were higher than the mode table tennis for individuals aged between 18 and 30 years old.

5. Discussion

The Flow Theory was tested in three different game modes Kinect Sports (Table Tennis) in XBOX Kinect, single-player, multiplayer and EXG network. Although statistically there have not been found significant differences between groups, multiplayer modes and EXG network showed the highest flow values. The EXG played online allows users to exchange information on a social network, however, instead of sharing photos, images and files, the players can share the game's motor experience, or the technique used to perform the movements of different sports or physical activities.

The EXG console differs from sedentary videogames (Bidiss and Irwin, 2010), due to the physical efforts and the physical abilities required by the game. In fact, all videogames demand cognitive activity and auditory and visual time of reaction, and the fingers coordination to manipulate the joystick during the game. Nevertheless, the EXG console requires other physical abilities, such as resistance, upper and lower limbs coordination, speed, strength, balance and flexibility to support the playability and the games storyline.

In this study, it was observed that during the online game some users have taught the opponent to serve, in other words, they performed the desired movement without any ball, while they orally explained to the other player. These procedures are similar to a Physical Education class, in which the teacher asks for the students' attention and performs the desired movements describing the movement.

Based on these results, although preliminary, we suggests that the experience with the multiplayer and the EXG network was an autotelic activity, self-motivated, in which the intrinsic motivation provided not only the interest in participating in the research, but also a willingness to continue playing. In pedagogical terms, it is an excellent environment to learn. According to Ghani and Deshpande, (1994) the self-motivated learning is an excellent way to learn, since when students are intrinsically motivated, they not only want to learn more, but they can also obtain more positive results in both classroom setting as in distance learning (Chan and Ahern, 1999).

The flow is an indicator of student satisfaction with learning in cyberspace, it is assumed that students in high state of flow are more likely to be satisfied with the online course than students in low-flow (Shin, 2006). The importance of the flow experience in a virtual environment was also investigated by Liao (2006), the results emphasize that the theory can be used as an indicator about the state of intrinsic motivation in virtual environments.

The balance between the intrinsic and extrinsic motivation is a concern for many educators. According to Ryan and Deci (2000) there are many activities prescribed and suggested as curricular activities in schools which are not designed to be intrinsically interesting, thus a central issue is how to motivate students intrinsically without an external pressure, without the collection of grades, assessments, in other words, without extrinsic motivation. Shernoff et al. (2003) have investigated the motivation of students, high school, in the classes under the perspective of the flow theory. The results indicate that the activities in which students consider academically intense and challenging, are related to the activities in which there is the largest engagement of students, so the learning environment becomes a great and positive experience.

It was noticed in this study that as players gained skills in the game, or could make the movements of the racket with greater precision, the more fun they had. The game challenge and the player's skill level should be in accordance with the user's age range, interaction and immersion must also be related to the player's age group (Pasch et al., 2009). These aspects were cited for the development of games, in which a very high level of challenge for a particular age group results in frustration, according to the same authors, while a very low level results in disinterest; the same happens with the level of skill required . Regarding the immersion aspects, two distinct types of movements were observed in the Nintendo Wii game, still by the same researchers: the competition and action sports. Pasch et al. (2009) have investigated 90 individuals, between men and women, athletes and students, the results indicate that when the challenge is related to competition, the user performs shorter movements only needed to score or to beat the opponent, the contrary to what occurs when users attempted to mimic the real sport. However, these aspects were not investigated in this study.

Regarding the physiological, the caloric expenditure promoted by the EXG, especially in children and young people of school age, is higher than sedentary games (video games), promoting an increase in the level of physical activity and heart rate, as an example the research with children between 8 and 12 years old by Lanningham-Foster et al. (2006) and young people between 13 and 16 years old of Graves et al. (2007). Similar results were found by Lanningham-Foster et al. (2009), which used samples from individuals with different ages: a group with 12 year-old children and another group with 34 year-old adults. As the number of involved muscles in the game is higher, the greater the energy expenditure is, Graves et al. (2008) analyzed the contribution of the upper limbs and found differences statistically significant between EXG and sedentary video games.

When the user spends more time playing and he/she advances to higher levels, the caloric expenditure also increases. That's what researchers Sell et al. (2008) have concluded, experienced DDR players expend more energy during the game, reaching the ACSM, comparing with the inexperienced players. Such findings can be extrapolated to all games, however, encourage players to stay longer playing is not interesting from the physiological point of view, because it may cause fatigue, dehydration and joint problems (Sparks et al. 2011). These findings emphasize the need for a teacher performance, mediating and adapting the use of EXG consoles as a mean to perform physical exercise, in which the frequency and regularity in an exercise program are more important than exercise intensity. In the case of this study, the duration of the matches was the factor that increases the caloric expenditure, in other words, the longer the match, the greater the caloric expenditure of the players.

In a study conducted in twenty schools in West Virginia (USA), involving the use of DDR (dance dance revolution) exergame in physical education and health classes, Lieberman (2006) states that some young people have lost about 4 (kg) after using it at school. Based on positive results raised by the study mentioned above, the state of West Virginia implemented the use of DDR in the curriculum of physical education in all its 765 public schools (Schiesel, 2007).

Mysirlaki et al. apud Paraskeva et al. (2009) says that young people play multiplayer games online approximately 2.53 hours per day, setting up an extensive

weekly load. Other problems, arising in the analysis context, including repetitive strain injuries, seizures, sleep disorders and addiction to online games are also cited by Badinand-Hubert et al. (1998) and Hsu et al. (2009). Thus, if we think hypothetically in EXGs as being part of everyday life for children and young people, we think that such games would become an excellent tool against childhood obesity.

Currently teaching PE, both in higher education and in school, still favors the income sport as content, the sport of performance that discards the fun (Barroso and Darido, 2006). The demotivation for physical exercise, especially at school, is attributed to the lack of playful activities. The students' exclusion in class, is also a worrying factor, in which the students who are more skilled are chosen in relation to others in the four team sports (football, handball, volleyball, basketball). There are pedagogical resistances to the new technologies of the 21st century, because the teaching methods of the past century still remain, as the transmission of the contents and forms of militaristic education in PE (Demo, 2009). The game is still little worked in schools, where sports prevail, Neira (2009) also emphasizes the educational potential of the game for PE at all levels of education.

Cyberspace takes a role in cultural reproduction, the formation of world point of views, skills, attitudes, values, among others (Gontijo et al, 2007). According to Alves (2000) cyberspace, acts in what Vygotsky called the Zone of Proximal Development (ZPD), because when networked the players learn through different perspectives and knowledge, allowing the passage from the real level of development to the level of potential development. The constant change of knowledge in the form of information within the network, demonstrates the communicative power of cyberspace. As the Internet spreads around the globe, especially in the educational institution, the capacity of collective intelligence increases, because the exchange of information between individuals of different ethnicities represents, unconditionally, an increase of interpretation regarding a common theme.

6. Conclusions

The preliminary results of this investigation show some possibilities for using Exergames in the teaching of Physical Education, using the Flow Theory, such as evaluation of the user's engagement and fun in the activity. The Exergame used in this study, the table tennis game from the XBOX Kinect console, allowed users to exchange information on a social network, however, instead of sharing photos, images and files, players shared the game's motor experience, the physical abilities involved and the technique used to perform the table tennis movements.

The procedures used by players to share information, resemble a physical education class in cyberspace. The teacher can use an audio-visual approach to teaching, the description of the motion is made verbally through the audio devices and the movements' visualization is done through the figure of the avatar.

Although there have not been found statistically significant differences for the Flow value, the multiplayer and EXG online groups had higher values. The game social interaction and experience with virtual reality provided the engagement and fun in the task; these aspects can be considered the keys to learning.

The caloric expenditure promoted by the games was higher for the boxing sport, due to a higher speed of arms movement. When the player spends more time playing and advance to higher levels, caloric expenditure also increases, the console asks the player if he is tired and proposes a break in each game to rest. These findings emphasize the need for teacher performance, mediating and adapting the consoles use as a mean to carry out planned and supervised exercise.

The relevance of Exergames for Physical Education lies not only in the form of classroom education, provided by a variety of themed games on physical activity and sport, but also a physical education without the necessity of attending a class. Exergame network allow the game between opponents separated geographically, from different cultures, enriching the learning environment. These games have the potential to become a virtual sports social network. As in *secondlife*, the exergames network players may carry over into virtual sports stadiums as famous Maracanã and Wimbledon Stadiums and challenge different players for a virtual match.

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